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EFFECTS OF FOOD DYES ON ADHD SYMPTOMS IN CHILDREN

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ABSTRACT

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common neurodevelopmental disorders in children. In recent years, research has focused on the role of artificial food dyes as a cause of ADHD symptoms. This paper conducts a secondary analysis of existing research to examine the potential correlation between food dyes and hyperactivity in children under the age of 19. Through a review of challenge studies, diet elimination trials, and neurobiological research, this study explains how food dyes affect brain activity and behavior. Despite opposing views that argue for more research to establish a causal relationship, the evidence suggests that artificial food dyes contribute to ADHD symptoms to a certain extent.

KEYWORDS: ADHD, Artificial Food Dyes, Hyperactivity, Brainwave Activity, Overstimulation

INTRODUCTION

Attention-Deficit/Hyperactivity Disorder (ADHD) is a common neurodevelopmental disorder that affects individuals worldwide (Rambler et al., 2022). It is characterized by symptoms of inattention, hyperactivity, and impulsivity. ADHD impacts many aspects of life, including academic and professional achievements, interpersonal relationships, and daily functioning (American Psychiatric Association, 2022). It disproportionately affects children, with 8.4% diagnosed compared to 2.5% of adults, and boys are diagnosed more frequently than girls due to differences in symptom presentation. While boys often exhibit hyperactivity, girls tend to show inattentiveness, which is more difficult to recognize and diagnose.

Artificial dyes are widely used in processed foods (Hopkins, 2024). For decades, their purpose has been to enhance visual appeal, creating vibrant hues in different colors. However, research suggests a link between these additives and adverse health effects. Concerns around artificial food dyes first emerged in the 1970s, when experiments on rats showed a correlation with cancer (Kobylewski & Jacobson, 2012). Further studies suggest that these petroleum-based chemicals may also contribute to behavioral issues in children (Rambler et al., 2022).

However, the relationship between artificial food dyes and ADHD symptoms remains controversial. While some studies suggest a link, others argue that additional research must be conducted. Specifically, three kinds of interactions should be examined: interactions with nutrients, interactions with medications, and interactions between food dyes themselves (D'Alessandro et al., 2022). The main objective of this paper is to analyze existing research, ultimately answering the question: How do food dyes influence behavioral symptoms of ADHD in children under the age of 19?

LITERATURE REVIEW

Overview of ADHD and Dietary Influences

ADHD has both genetic and environmental causes, but diet is a factor that can be modified. Past research indicates that Western-style diets (junk food, processed food, refined sugars) are linked to an increased risk of ADHD (Pinto et al., 2022). Meanwhile, healthier diets like the DASH, elimination, and Mediterranean diets may help reduce this risk.

a. Healthy Diets and ADHD Risk

DASH Diet: This is a well-known eating pattern that includes high amounts of fruits, vegetables, low-fat dairy products, vitamin C, and low amounts of simple sugars (Pinto et al., 2022). In a 12-week randomized controlled clinical trial conducted in Iran, this dietary pattern was found to improve ADHD symptoms. Results were measured using the Abbreviated Conners Scale, the 18-item Swanson, Nolan, and Pelham Scale, and the Strengths and Difficulties Questionnaire.

Mediterranean Diet: This emphasises plant-based foods and healthy fats, with common components including vegetables, fruits, and whole grains (Pinto et al., 2022). A case-control study with 120 children (60 newly diagnosed with ADHD and 60 controls) found that lower adherence to a Mediterranean diet was linked to a higher likelihood of ADHD diagnosis.

b. Unhealthy Diets and ADHD Risk

Western Diet: This involves processed meats, refined cereal grains, and soft drinks. It has been shown to increase the risk of ADHD by 92% (Pinto et al., 2022).

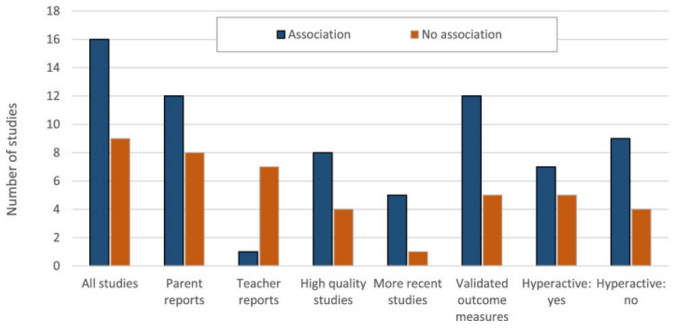
Junk Food Diet: This is characterized by a high consumption of processed foods and refined sugars. It is linked to a 51% higher risk of ADHD (Pinto et al., 2022).

Historical Research on Food Dyes and Hyperactivity

The debate over artificial food dyes and hyperactivity has been highly controversial. Some studies support the link between food dyes and behavioral issues, while others do not.

a. Evidence Supporting a Link

1. A 2012 meta-analysis by Nigg et al. (2012) supports the idea that food dyes are linked to adverse behavioral effects in children. It is estimated that 8% of children with ADHD may have symptoms related to synthetic food dyes.
2. image below (Miller et al., 2022) presents the results of a review, showing the number of clinical studies that reported adverse neurobehavioral outcomes based on key study methodologies. The majority (25) were challenge studies, in which children were directly exposed to food dyes, while 2 were diet elimination studies.



Source: Environmental Health (2022)

Figure 1: Number of clinical studies reporting positive associations by key study variables

Of the challenge studies, 64% (16/25) reported evidence of an association between synthetic food dyes and neurobehavioral effects in children (Miller et al., 2022). Furthermore, 52% (13/25) found statistically significant associations.

3. 3. A Harvard and Columbia University review estimated that removing artificial food colorings from the diets of children with ADHD could be one-third to one-half as effective as methylphenidate (Ritalin) treatment (Schab & Trinh, 2004).
4. 4. A study by McCann et al. (2007) investigated the impact of artificial food dyes on hyperactivity in children. 153 three-year-olds and 144 8-9 year-olds participated in a double-blind, placebo-controlled crossover trial where children were given either a drink containing artificial food dyes or a placebo. Both age groups showed increased hyperactivity after consuming the artificial colorings. Effects were measured using teacher and parent ratings as well as computerized attention tests.
5. 5. A study by Bateman et al. (2004) tested the impact of artificial colors on hyperactivity in three-year-olds. The 277 preschool-aged children were given either an artificial color-free diet or a diet containing artificial colors. Results showed that removing artificial colors led to improved behavior.

b. Evidence Disproving a Link

1. A 2012 meta-analysis by Nigg et al. (2012) reviewed past research on artificial food colorings and ADHD symptoms. Parent reports yielded an effect size of 18% which decreased to 12% after adjustment for publication bias. Teacher reports only yielded an effect of 7%. Therefore, while some studies suggested mild improvements, the overall impact was small and inconsistent.
2. A 2012 review by Millicap and Yee found that while certain diets (like elimination) had some effect on a small group of children, the impact of artificial food colors is inconsistent. Many studies show a link had small sample sizes or lacked objective assessments.

METHODOLOGY

This study is based on secondary data from existing studies that have examined the effects of food dyes on ADHD in children. Many of these reports are published on PubMed, a resource provided by the National Library of Medicine.

Studies meet the following four key criteria:

1. conducted on human participants.
2. Follow a clinical trial design.
3. Participants were exposed to either a known quantity of food dyes or a diet low in food dyes.
4. The studies assess neurobehavioral outcomes, specifically hyperactivity or intention.
5. The majority of participants in these studies are 19 years or younger.

Analysis will include both qualitative data (e.g., parent and teacher reports) and quantitative data (e.g., behavioral scales). This mixed-method approach allows for a more comprehensive understanding of the relationship between food dyes and ADHD symptoms.

DISCUSSION & ANALYSIS

This paper suggests a link between food dyes and an increased risk of ADHD symptoms in children. While it is uncertain whether food dyes can cause new cases of ADHD, numerous challenge and diet elimination studies indicate they can worsen symptoms in children with pre-existing ADHD (Miller et al., 2022).

Why does this happen?

Animal studies show that food dyes impact neurobehavioral outcomes, particularly sensory processing and behavioral regulation. Erikson et al. (2014) reported increased activity in male rats given synthetic food dyes at doses below twice the No-Observed-Adverse-Effect-Level (NOAEL). Similarly, Shaywitz et al. (1979) and Goldenring et al. (1980) found increased activity and reduced habituation in rodents exposed to doses near the Acceptable Daily Intake (ADI). Despite being considered non-harmful, these doses still led to symptoms of hyperactivity.

Human studies further support these findings. They have demonstrated how food dye exposure increases brainwave

activity, leading to overstimulation. In a double-blind, crossover challenge, participants consumed 225 mg of artificial food colors hidden in chocolate cookies or placebo cookies for three days per week, with testing on the third day (Kirkland et al., 2022). Results showed that food dyes increased brainwave activity in college students with ADHD. Furthermore, synthetic food dyes like Yellow No. 5 (Tartrazine) and Red No. 40 can disrupt neurotransmitter systems that regulate mood, attention, and behavior.

What is the broader impact?

Food dyes are widely used in processed foods. More than 36,000 American food products contain Red 40, and over 8,000 products contain Red 3 (Bailey, 2024). If the relationship between food dyes and ADHD symptoms is confirmed, it could lead to public health interventions, such as dietary modifications for children with ADHD.

Proper ADHD treatment is essential for enhancing quality of life. It can improve academic success and social relationships. Moreover, effectively managing ADHD can help individuals better handle chronic health conditions, extending life expectancy by 9 to 13 years (CHADD & Barkley, 2019).

What actions are recommended?

While it remains unclear whether food dyes directly cause ADHD, research suggests they can worsen pre-existing symptoms. Given this, cautionary measures should be taken.

Food Labeling

Clear labeling of products containing artificial food dyes should be mandated. This would ensure that consumers are informed about what they are purchasing, allowing children with ADHD to make more cautious dietary choices.

Lowering Acceptable Doses

In the United States, current Food and Drug Administration (FDA) regulations are inadequate. Research suggests that for 4 synthetic dyes with animal studies reporting neurobehavioral effects, lower ADIs would be more appropriate (Miller et al., 2022). Dietary exposure in children, including over-the-counter medications and vitamins, may further exceed safe levels.

A dose-response study by Rowe & Rowe (1994) on Yellow No. 5 (Tartrazine) tested doses ranging from 1mg to 50mg per day. Results showed that higher doses led to statistically significant increases in ADHD-related symptoms. If the ADI for Yellow No. 5 were based on these findings, the safety threshold would be much lower.

Bans on Food Dyes

Many countries, including those within the European Union, either restrict or ban food dyes (Hopkins, 2024). The U.S. is one of the few industrialized countries that has yet to implement strict regulations. While the FDA recently banned Red Dye No. 3 (Rosenbluth, 2025), other dyes pose similar risks and may be equally, if not more, harmful.

CONCLUSION

While the link between food dyes and new ADHD cases requires further research, there is strong evidence to show that food dyes worsen existing symptoms. Studies suggest that they exacerbate hyperactivity in children by affecting brainwave activity and neurotransmitter systems. Given these findings, this paper calls for policy changes. Governments should mandate the labeling of foods containing synthetic dyes, lower the acceptable dosage amounts, and ban harmful dyes. The visual appeal of food should not come at the cost of children's health. As Dr. Russell A. Barkley states, "Our research shows that ADHD is much more than a neurodevelopmental disorder—it's a significant public health issue" (CHADD & Barkley, 2019).

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